



Developing a 21st Century Engineering Workforce

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The Problem

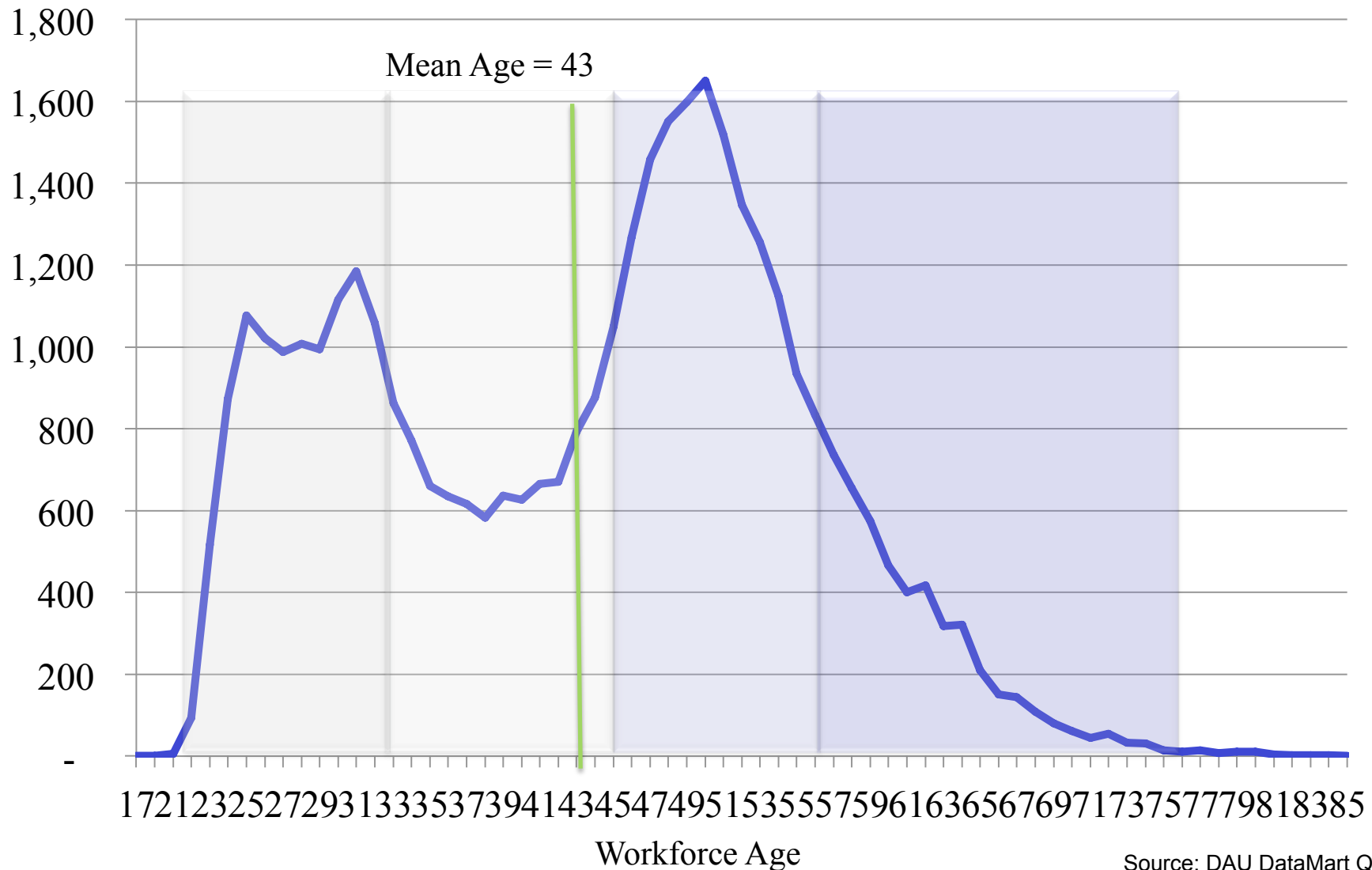
Many years of Systemic Root Cause Data show a correlation between DoD program technical failures and engineering staffing levels / technical skills.

Factors Bearing on the Problem:

- **Our current model: minimal certification versus full qualification**
 - **On-the-job execution versus traditional academic programs.**
 - **Critical skills learned via on-the-job experience and hands-on practice.**
- **There is an imminent demographic crisis in DoD engineering workforce**



Engineering Workforce Demographics



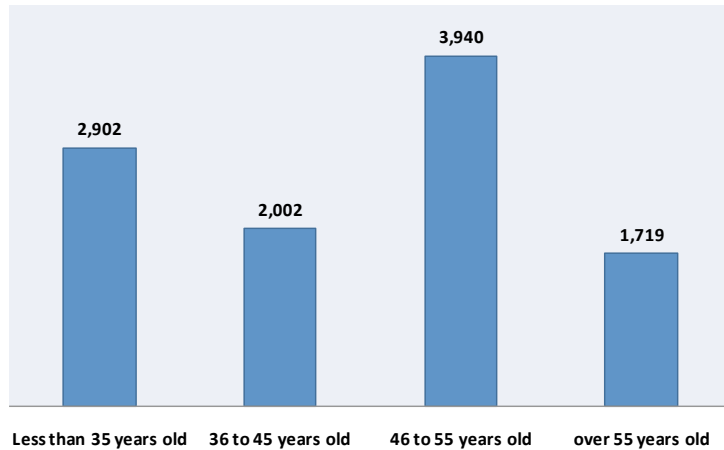
Source: DAU DataMart Q1 2011



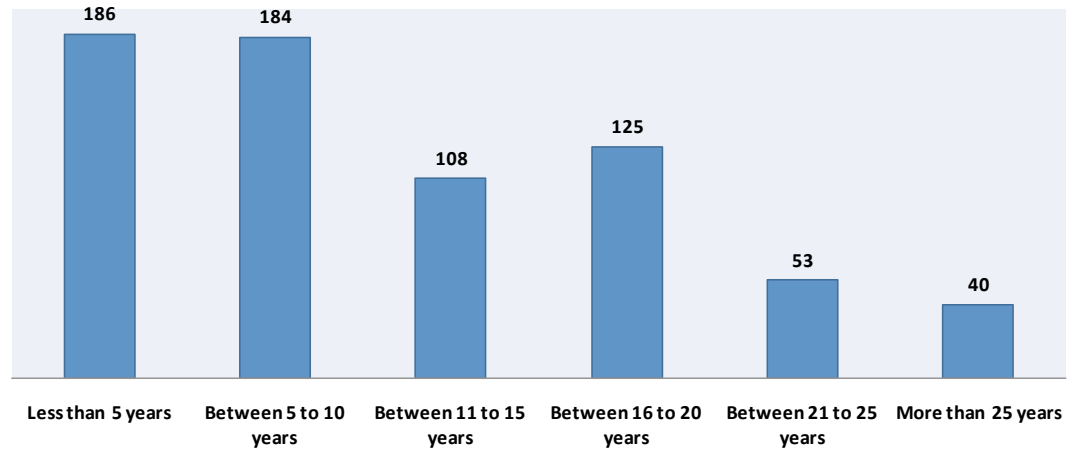
SPRDE-SE/PSE Assessment Demographics – 10,648 participants



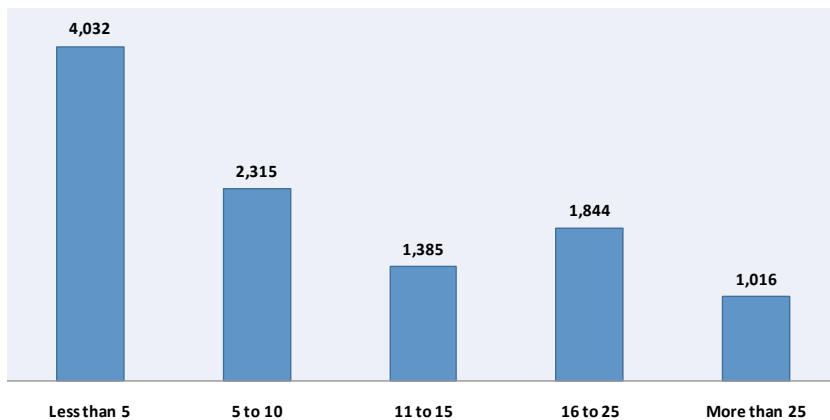
Age of Participants



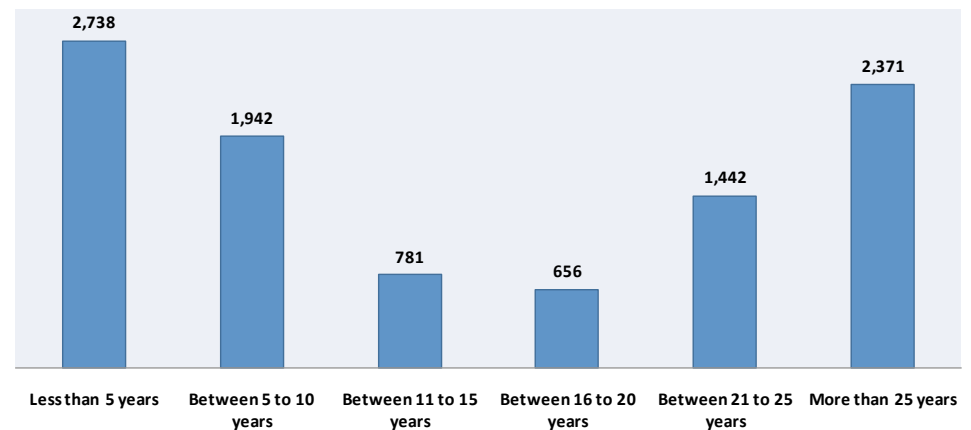
Active Duty Participants -Total Years of Service



Participants' Systems Engineering Experience (yrs)



Civilian Participants -Total Years of Federal Civil Service





Vision and Goals

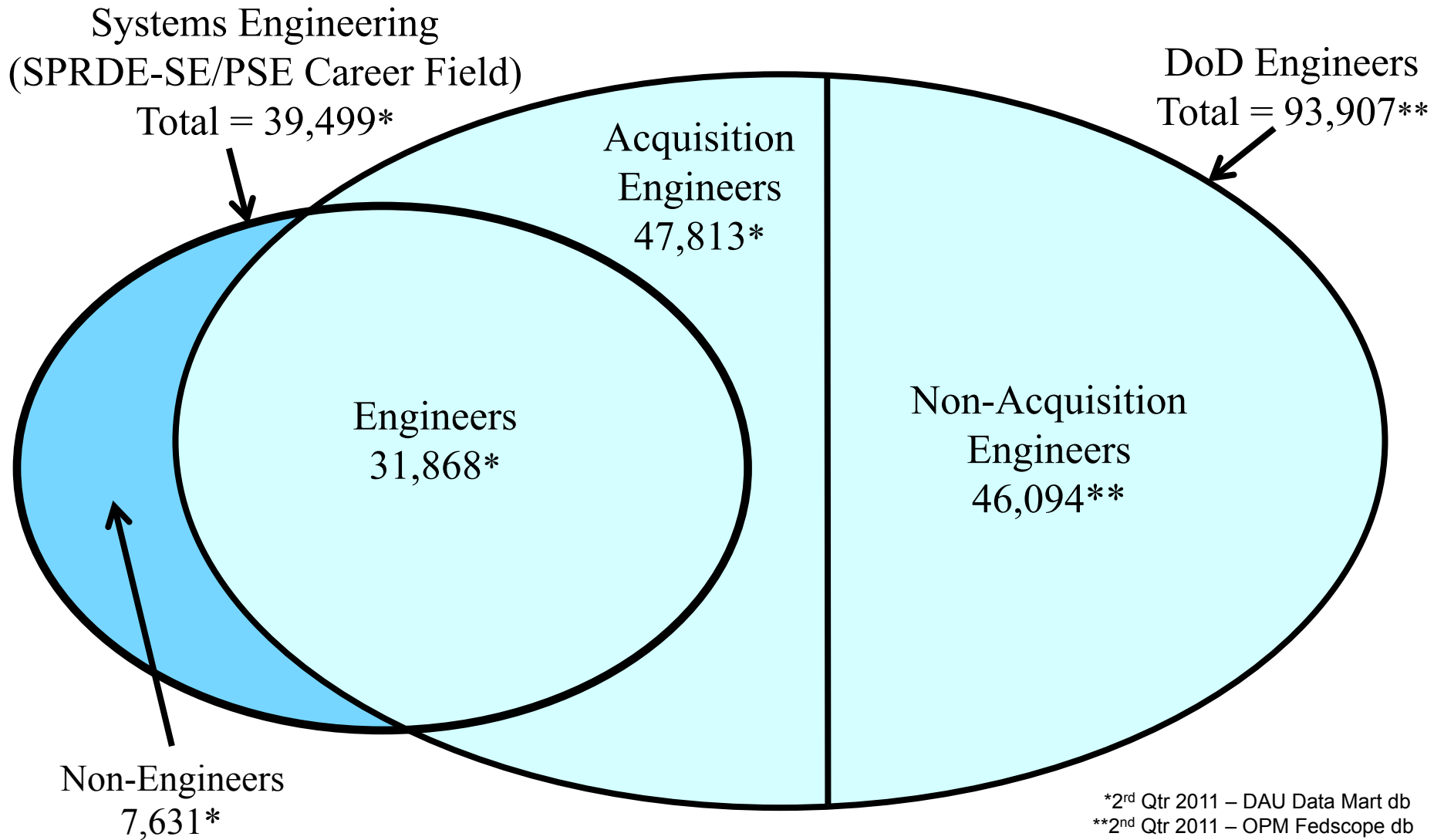
Vision: An engineering workforce with the capability, capacity and competence needed to address 21st Century acquisition technical and programmatic challenges.

Goals:

- Establish a process that leverages workforce development and robust certification and qualification as the foundations for cultural and technical revitalization of the DoD Engineering Enterprise.
- Determine the essential technical knowledge, skills and abilities needed by practicing DoD Systems Engineers to contribute to the technical success of acquisition programs across all experience levels.



Target Audience: DoD Engineers





Objectives



- Revitalize and reinvigorate “Engineering Culture” of the Department.
- Enable and ensure consistency in technical capabilities across the Department.
- Transition from a “minimally certified” to a “fully qualified” workforce.
- Maintain core principles of depth, breadth and leadership in engineering workforce career development.



Core Principles of a 21st Century Engineering Workforce



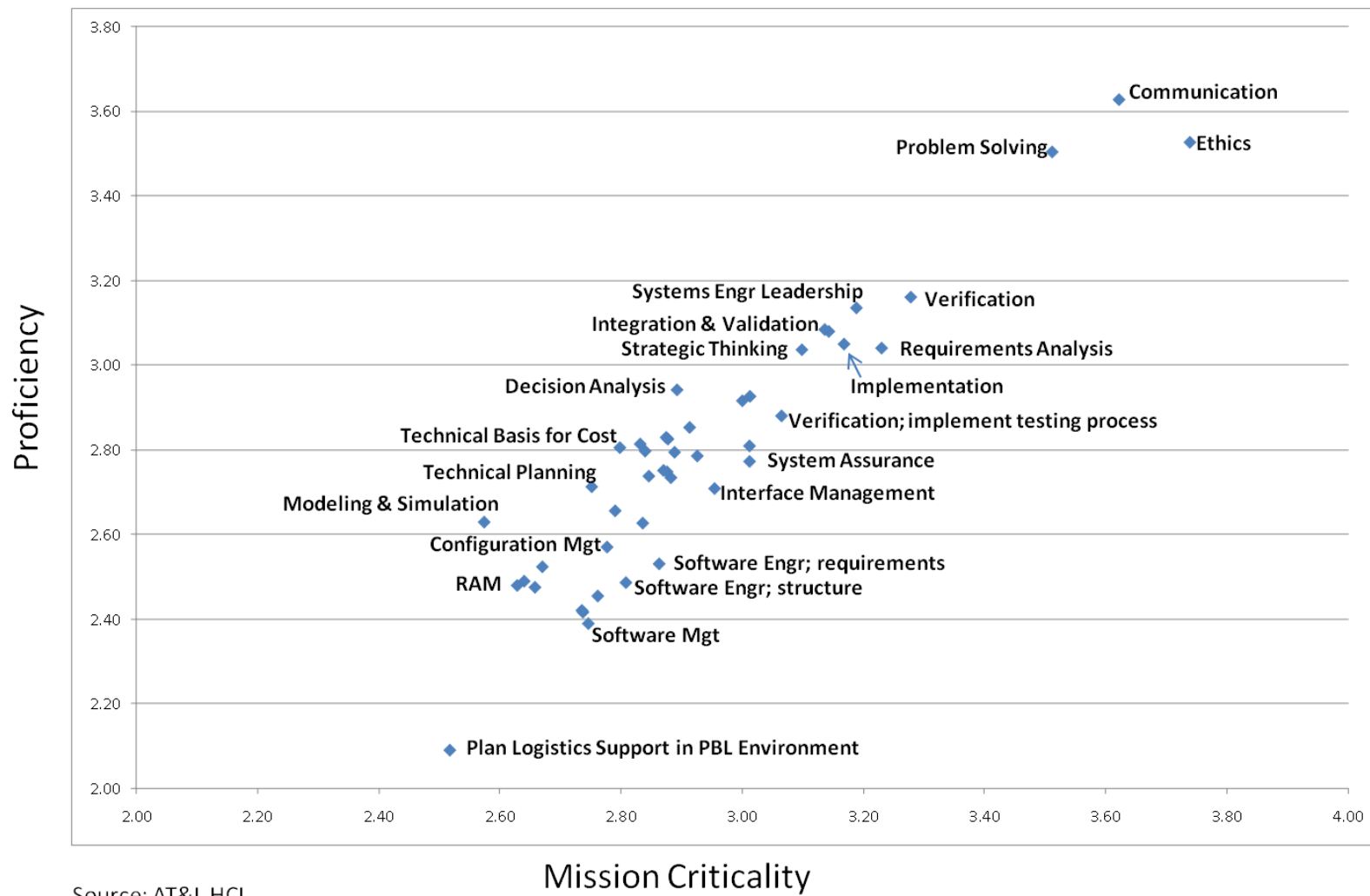
- **Depth**
 - Extensive expertise and experience in one or more engineering disciplines and in one or more product domains
- **Breadth**
 - Awareness of and appreciation for other functional areas
 - Understanding of the system lifecycle and processes
 - Knowledge of other engineering disciplines, cross-disciplinary impacts and how they integrate into the system solution
 - Knowledge of product domains
- **Leadership**
 - Ability to motivate and inspire individuals and teams
 - Comfort in dealing with complexity
 - Focused on underpinning decisions with data
 - Capability to make tough technical decisions



SPRDE-SE/PSE Plot of DoD-Wide Proficiency and Mission Critical Ratings from Assessment



Scale 1 – 5; 5 = very proficient, very mission critical





Achieving the Goals and Objectives



To achieve the goals and objectives, we are addressing the following questions:

1. What are the most impactful roles and the most common roles played by the engineering workforce?
2. What do these people actually do – what is the job description, goals, and tasks/practices for each of these roles?
3. What are the most critical competencies (i.e., behaviors, knowledge, skills, and abilities) – technical and other – and the required proficiency levels for each of these roles?

After we understand the answers to these questions, with validation from the engineering workforce at all levels, we plan to construct an engineering development model that refashions the DAU curriculum (position category descriptions, job descriptions, certification and qualification standards, on-the-job training and mentoring programs, etc.) to motivate and enable the workforce to effectively execute these roles.



Skills and Teaching Venues Required for Selected AF SE Assessment Model (SEAM) Process Areas



Gathering data: Engineers were requested to provide skills and education/training venues required to complete the tasks listed for the AF SEAM Process Areas provided below:

Process Areas:

- Design
- Manufacturing
- Requirements
- Risk Management
- Transition, Fielding, & Sustainment
- Verification & Validation

Education/Training Venue:

- Formal Education
- Training
- OJT
- Mentoring



SERC Research Provides Learning Resources



A major thrust of the SERC is academic research that explores future workforce competencies and approaches to cultivate, educate, and prepare the future SE workforce – this research will provide essential learning content for 21st Century engineers.

- RT–1 Body of Knowledge and Curriculum to Advance Systems Engineering (BKCASE)
- RT–4 Technical Leadership
- RT–16 Experience Accelerator
- RT-19& 19A SE Capstone Courses



Summary



Ultimate Goal: Work with members of the engineering workforce at all levels to develop a comprehensive and validated matrix of roles vs. competencies along with resultant learning outcomes that can guide the construction of a 21st Century Engineering Development model.

We will use this engineering development model to:

- Drive to achieve engineering core principles**
- Enable technical consistency across the Department.**
- “Raise the bar of excellence in engineering practice” to improve critical acquisition programs.**



Back-Up



SERC Research Provides Learning Resources (1)



- **RT-1 Body of Knowledge and Curriculum to Advance Systems Engineering (BKCASE)**
 - ✓ Provides up-to-date reference material to enhance learning content
 - ✓ Provides comprehensive guide for constructing the engineering development model

- **RT-4 Technical Leadership**
 - ✓ Provides major part of leadership content
 - ✓ Covers Systems, Business, and Enterprise leadership skills
 - ✓ Could be extended to cover entry- to expert-level leadership



SERC Research Provides Learning Resources (2)



- **RT-16 Experience Accelerator**
 - ✓ Creates new paradigm with potential to speed up (2X?) development of senior systems engineers
 - ✓ Provides necessary skills to address emerging systems challenges in an economically attractive manner

- **RT-19& 19A SE Capstone Courses**
 - ✓ Provides early-on exposure to DoD problem areas
 - ✓ Provides jumpstart to systems thinking for future engineering workforce
 - ✓ Provides entry-level workforce candidates that can hit the ground running
 - ✓ Provides lessons learned and promising practices on incorporating SE principles into the curriculum
 - ✓ Provides enhancements to the engineering development model



Workforce Development

- **Implementing statutory responsibility under WSARA to provide guidance, oversight and advocacy for the SE Workforce**
 - Department remains committed to growing SE human capital capacity and capability
 - Total SPRDE/Systems Engineering Workforce: 39,201
 - Growth since 2009: 2,497
- **Established Key Leader Professional Development Program**
 - Responds to Sec 820 of PL 109-364 that requires “properly qualified” individuals in key positions on major defense acquisition programs and USD(AT&L) memo on Key Leader Positions
 - Program Lead Systems Engineer is a mandatory Key Leader Position
 - Currently developing core Key Leader qualifications in four major areas: Program Management, Technical Management, Business Management, and Executive Leadership

“A capable, qualified, and appropriately sized acquisition workforce will be key to achieving efficiency.”

-- Ashton B. Carter, USD(AT&L)



Systems Engineering Challenges



- **Start programs right with strong early SE**
- **Expand the aperture of DoD engineering practice to address 21st century technical challenges**
- **Create the tools to support rapid capability delivery**
- **Reinvigorate Defense Standardization**
- **Address increased priority for program protection**
- **Perform robust reliability and maintainability engineering**



Achieving the Goals and Objectives (1)



To achieve the goals and objectives, we need to address the following questions:

- 1. What are the most impactful roles and the most common roles played by the SPRDE-SE/PSE workforce?**
 - Roles could include Chief Engineer, Architect, Requirements Manager, Software Engineer, Domain Engineer, etc.
 - We want to affect people filling these roles first.
- 2. What do these people actually do – what is the job description, goals, and tasks/practices for each of these roles?**
 - This is where the needs for technical depth, breadth and leadership should emerge.



Achieving the Goals and Objectives (2)



3. What are the most critical competencies (i.e., behaviors, knowledge, skills, and abilities) – technical and other – and the required proficiency levels for each of these roles?
 - This is where the specific competencies that correspond to technical depth, breadth and leadership should emerge.
 - We are talking about more than SE – we need to explore the full range of science, technology, engineering, and math competencies that are needed by the SPRDE-SE/PSE workforce.
4. Once we understand the answers to questions 1 – 3 with validation from the SPRDE-SE/PSE workforce at all levels, we plan to construct an engineering development model that refashions the Defense Acquisition University curriculum, position category descriptions, job descriptions, certification and qualification standards, on-the-job training and mentoring programs, etc., to motivate and enable the workforce to effectively execute these roles.